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where the discrepancy is rather more than four times its probable error.

The attempt was made, by comparison between Greenwich and Cambridge, 1875 (Professor Rogers's Catalogue of 1213 stars), to come to a more distinct conclusion on this matter; but the only result was to exhibit a somewhat larger and more extended periodicity in the differences for polar stars, so that I must defer further study on this point till I have accumulated a larger stock of materials.

Williams' College Observatory:
1890 *May* 29.

The Star-Places of the Second Melbourne General Catalogue for 1880. By A. M. W. Downing, M.A.

For the purpose of discussing the star-places of the Second Melbourne General Catalogue for 1880, they have been compared with those of the Cape Catalogue for the same epoch. In some cases different values of the proper motions have been adopted in reducing the observations from the mean dates of observation to the common epoch of the two catalogues. It has, however, been assumed that the effect of the adopted proper motions would not sensibly affect the comparison, when such a large number of stars are available, as is the case in the present instance. Every star common to the catalogues, and which has been observed in both elements in each, has been used in the comparison. Only one *erratum* has been detected during the progress of the work—viz. Melbourne No. 43, for N.P.D. 83° 3′ 5″·27 read 83° 4′ 5″·27.

Table I., given below, gives the differences Cape—Melbourne when the stars are arranged in order of N.P.D., and grouped as shown in the table. The columns "curve" give the readings from curves drawn through the several differences, when laid down as points on cross-ruled paper. It will be seen that the mean differences in R.A. and N.P.D. are $+0^s{\cdot}013$ and $+0''{\cdot}61$ respectively; and that the total number of stars used in the comparison is 881.

Table II. gives the same details as Table I., the stars in this instance, however, being arranged in order of R.A., and the mean differences having been applied, with reversed signs, to the hourly means before their entry in this table.

Tables III. and IV. are formed by reading off from the curves mentioned above the quantities corresponding to the beginning of each hour of R.A., and each 5° of N.P.D.

By the aid of the tables printed on pages 453 and 454 of

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vol. xlvii. of the *Monthly Notices*, the comparison is extended so as to include the Cordoba and First Melbourne General Catalogue. In the formation of Tables III. and IV. it must be remarked that the signs of the quantities shown have been arranged so as to give corrections applicable to the star-places of the Cape, Cordoba, and First Melbourne Catalogues, in order to reduce them respectively to the system of the Second Melbourne General Catalogue for 1880.

TABLE I.

N.P.D.	$\Delta\alpha$		$\Delta\delta$		No. of Stars in group.
	Means.	Curve.	Means.	Curve.	
° °	s	s	″	″	
40–50	−0·016	...	−0·85	...	5
50–60	+ ·013	+0·003	−0·71	−0·59	7
60–65	+ ·001	+ ·005	−0·09	− ·17	17
65–70	+ ·006	+ ·006	+0·22	+ ·25	22
70–75	+ ·008	+ ·005	+0·62	+ ·40	14
75–80	·000	− ·002	+0·12	+ ·24	21
80–85	− ·016	− ·012	+0·07	+ ·13	27
85–90	− ·013	− ·007	+0·25	+ ·27	25
90–95	+ ·014	+ ·003	+0·48	+ ·53	44
95–100	− ·005	+ ·003	+0·89	+ ·80	42
100–105	+ ·006	+ ·009	+0·91	+ ·85	52
105–110	+ ·026	+ ·019	+0·68	+ ·75	44
110–115	+ ·017	+ ·017	+0·72	+ ·67	38
115–120	+ ·004	+ ·008	+0·56	+ ·64	20
120–125	+ ·005	+ ·017	+0·71	+ ·62	90
125–130	+ ·050	+ ·036	+0·48	+ ·62	78
130–135	+ ·036	+ ·039	+0·78	+ ·71	100
135–140	+ ·031	+ ·037	+0·79	+ ·78	73
140–145	+ ·047	+ ·052	+0·75	+ ·79	17
145–150	+ ·081	+ ·068	+0·86	+ ·79	20
150–155	+ ·061	+ ·040	+0·70	+ ·70	14
155–160	− ·044	− ·012	+0·52	+ ·70	15
160–165	− ·019	− ·053	+1·04	+ ·86	8
165–170	− ·127	− ·084	+0·84	+ ·92	17
170–175	− ·063	− ·056	+0·95	+ ·73	41
175–180	+ ·024	...	+0·16	...	30
40–180	+0·013	...	+0·61	...	881

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TABLE II.

R.A.	Δα Means.	Δα Curve.	Δδ Means.	Δδ Curve.	No. of Stars in group.
h h	s	s	″	″	
0–1	+0·030	+0·020	−0·06	+0·20	51
1–2	− ·004	+ ·014	+ ·40	+ ·20	50
2–3	+ ·031	+ ·010	+ ·06	+ ·07	46
3–4	− ·021	− ·007	− ·25	− ·04	40
4–5	− ·015	− ·017	+ ·30	+ ·16	38
5–6	− ·014	− ·013	+ ·25	+ ·21	49
6–7	− ·008	− ·014	+ ·03	+ ·07	40
7–8	− ·026	− ·015	− ·05	+ ·04	40
8–9	+ ·003	− ·002	+ ·22	+ ·08	49
9–10	+ ·012	+ ·015	− ·08	− ·02	41
10–11	+ ·030	+ ·033	− ·14	− ·13	41
11–12	+ ·058	+ ·047	− ·16	− ·22	36
12–13	+ ·039	+ ·035	− ·42	− ·33	32
13–14	+ ·001	+ ·032	− ·31	− ·39	25
14–15	+ ·084	+ ·036	− ·49	− ·43	24
15–16	− ·028	+ ·015	− ·48	− ·39	22
16–17	+ ·030	+ ·005	− ·17	− ·35	25
17–18	− ·012	− ·006	− ·55	− ·35	27
18–19	− ·029	− ·015	− ·10	− ·30	31
19–20	+ ·014	− ·005	− ·41	− ·25	26
20–21	− ·016	− ·025	− ·07	− ·24	27
21–22	− ·081	− ·042	− ·39	− ·16	34
22–23	+ ·013	− ·008	+ ·24	+ ·15	38
23–24	+ ·023	+ ·023	+ ·50	+ ·30	49

TABLE III.

R.A.	Cape, 1880.		Cordoba, 1875.		Melbourne, 1870.	
h	s	″	s	″	s	″
0·0	−0·021	−0·25	+0·003	−0·06	+0·012	−0·02
1·0	·017	·20	·010	·06	+ ·011	− ·08
2·0	·011	·14	·005	− ·04	− ·015	·00
3·0	− ·003	·01	·007	+ ·01	·046	+ ·22
4·0	+ ·013	·04	·033	− ·11	·032	·23
5·0	·016	·20	·026	·27	− ·001	+ ·03
6·0	·014	·15	+ ·001	·27	+ ·008	− ·09
7·0	·016	·04	− ·016	·19	− ·008	·09
8·0	+ ·010	·05	·020	·16	·036	− ·04
9·0	− ·007	− ·03	·021	− ·07	·054	+ ·06
10·0	·024	+ ·08	·018	+ ·07	·059	− ·02
11·0	·042	·18	·038	·12	·057	·14

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R.A.	Cape, 1880.		Cordoba, 1875.		Melbourne, 1870.	
h	s	″	s	″	s	″
12·0	−0·041	+0·28	−0·074	+0·22	−0·038	−0·12
13·0	·032	·36	·072	·33	·015	− ·06
14·0	·032	·42	·057	·35	− ·009	+ ·16
15·0	·024	·43	·033	·29	+ ·012	·28
16·0	− ·010	·37	− ·011	·23	·032	·24
17·0	·000	·35	+ ·006	·26	·029	·27
18·0	+ ·012	·32	·023	·36	·022	·26
19·0	·010	·27	·023	·39	·010	·28
20·0	·015	·25	·034	·39	·017	·35
21·0	·033	·21	·058	·44	·052	·37
22·0	+ ·028	+ ·03	·053	·30	·060	·23
23·0	− ·010	− ·23	+ ·010	+ ·02	+ ·021	+ ·02

TABLE IV.

N.P.D.	Cape, 1880.		Cordoba, 1875.		Melbourne, 1870.	
°	s	″	s	″	s	″
55	−0·003	+0·59	...	...	−0·010	−0·31
60	·004	+ ·33	...	...	·006	·32
65	·005	− ·02	...	...	·002	·33
70	·005	·35	...	...	− ·001	·34
75	− ·002	·31	...	...	+ ·011	·09
80	+ ·008	·17	...	...	·025	·25
85	·011	·18	...	...	·020	·41
90	+ ·002	·39	...	...	+ ·002	·49
95	− ·004	·67	−0·032	+0·05	− ·009	·52
100	·006	·85	·038	− ·14	·020	·50
105	·013	·80	·051	·10	·038	·31
110	·019	·70	·060	·33	·056	·26
115	·011	·65	·059	·46	·049	·35
120	·010	·63	·074	·31	·046	·44
125	·026	·63	·091	·31	·051	·48
130	·038	·67	·098	·47	·052	·37
135	·038	·76	·116	·44	·064	·26
140	·044	·78	·132	·28	·077	·26
145	·060	·79	·108	·26	·073	·25
150	·053	·75	·063	·28	·058	− ·11
155	− ·015	·70	− ·044	·28	·039	+ ·03
160	+ ·032	·77	·000	·33	·037	·07
165	·070	·90	+ ·077	·10	−·013	+ ·03
170	·070	·87	·128	·04	+·003	− ·04
175	+ ·041	− ·70	+ ·154	− ·23	−·022	− ·10

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Corrections to the Elements of the Orbit of Juno.
By A. M. W. Downing, M.A.

My attention having been drawn to the large and increasing errors of the computed places of *Juno*, as given in the *Nautical Almanac* (amounting to some 3′ in geocentric longitude in 1887), I have endeavoured in the present paper to deduce corrections to the assumed elements of the orbit, so as to obtain elements which shall represent the observed places of the planet with sufficient accuracy for, I hope, some years to come.

The observations of *Juno* which are discussed in this paper are those published in the volumes of *Greenwich Observations* from 1864 to 1887 inclusive. The discussion therefore embraces observations made at the Paris Observatory during the years 1864 to 1878, as well as those made at Greenwich during the whole period. Le Verrier's Tables of the Sun were first used in the *Nautical Almanac* for the year 1864, and it has been assumed that the tabular places of the Sun are sensibly accurate throughout the years with which we are here concerned.

The first step in the discussion of the observations, both Greenwich and Paris, is to reduce them to a uniform system. That adopted for the R.A.'s is the standard system of R.A.'s deduced from 12-hour groups of clock-stars for 1872·0, printed on pp. 21 and 22 of the Introduction to the *Greenwich Nine-Year Catalogue*, and which has been used in the reduction of the Greenwich observations for 1878 to 1888 inclusive. For the years 1864 to 1869 the Greenwich R.A.'s depend on those of the First Seven-Year Catalogue, whilst for the years 1872 to 1877 they depend on those of the Second Seven-Year Catalogue. The following table (deduced from the comparisons printed on page 8 of the above-mentioned Introduction) gives the corrections applicable to the R.A.'s observed at Greenwich during the specified periods to reduce them to the adopted system:—

R.A.	1864—1869.	1870—1877.
h h	s	s
0–3	+0·02	+0·02
3–6	− ·01	+ ·01
6–9	− ·02	·00
9–12	− ·01	+ ·01
12–15	·00	+ ·01
15–18	·00	+ ·01
18–21	+ ·02	+ ·03
21–24	+ ·03	+ ·03

Observations made since 1878·0 require no correction.

In the reduction of the Paris observations of R.A. a "provisional" standard catalogue (constructed in 1854) was used